

Hall, Baroni & Denton [2004]

Low-order gravity field & sea-level: Antarctic contribution to Late-Pleistocene & Holocene ocean volume changes

E. R. Ivins R. S. Gross X. Wu

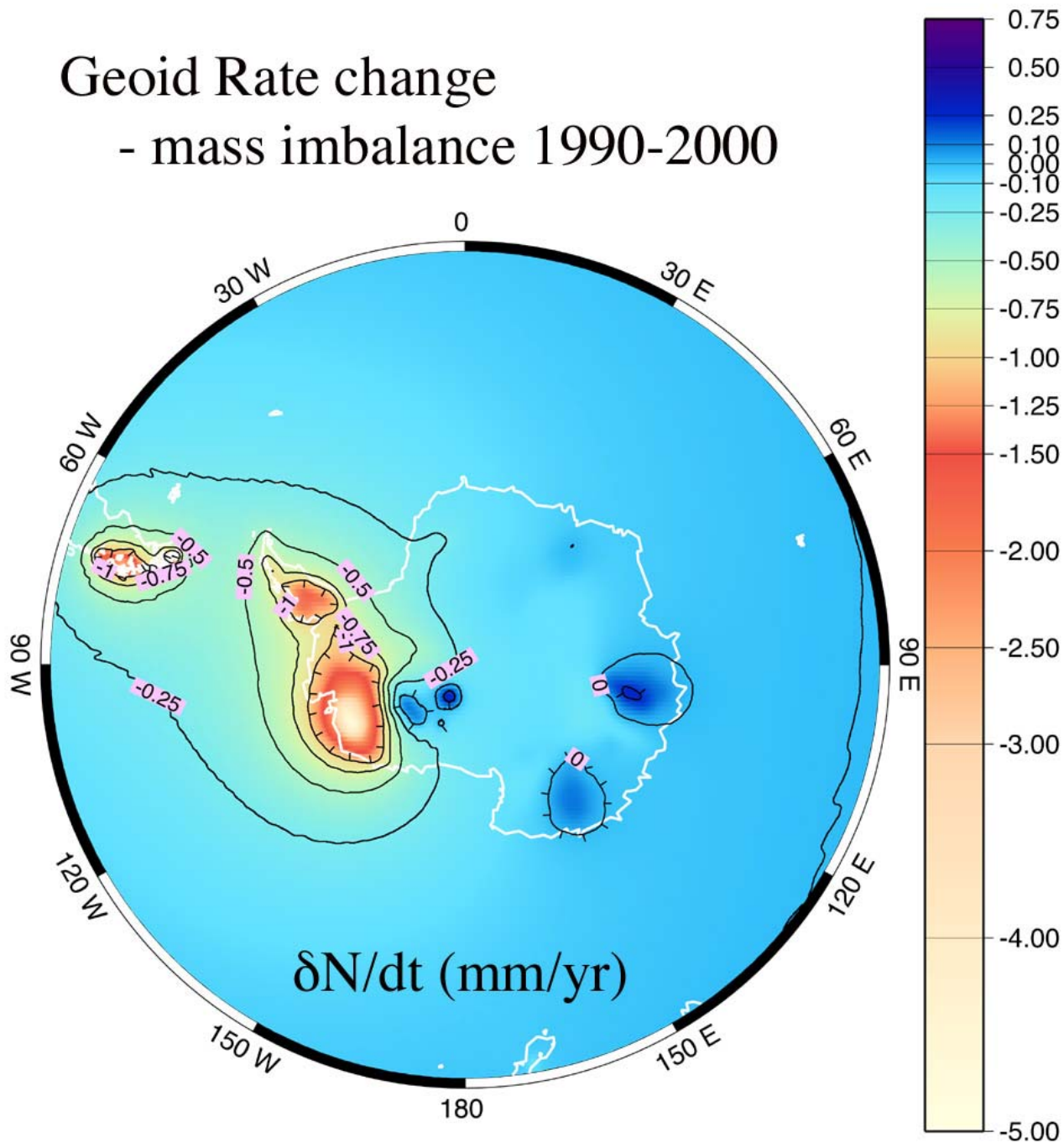
JPL/Caltech Pasadena, California, USA

5/31/2005

IAMAS 2005 Beijing Aug. 2-11,
2005

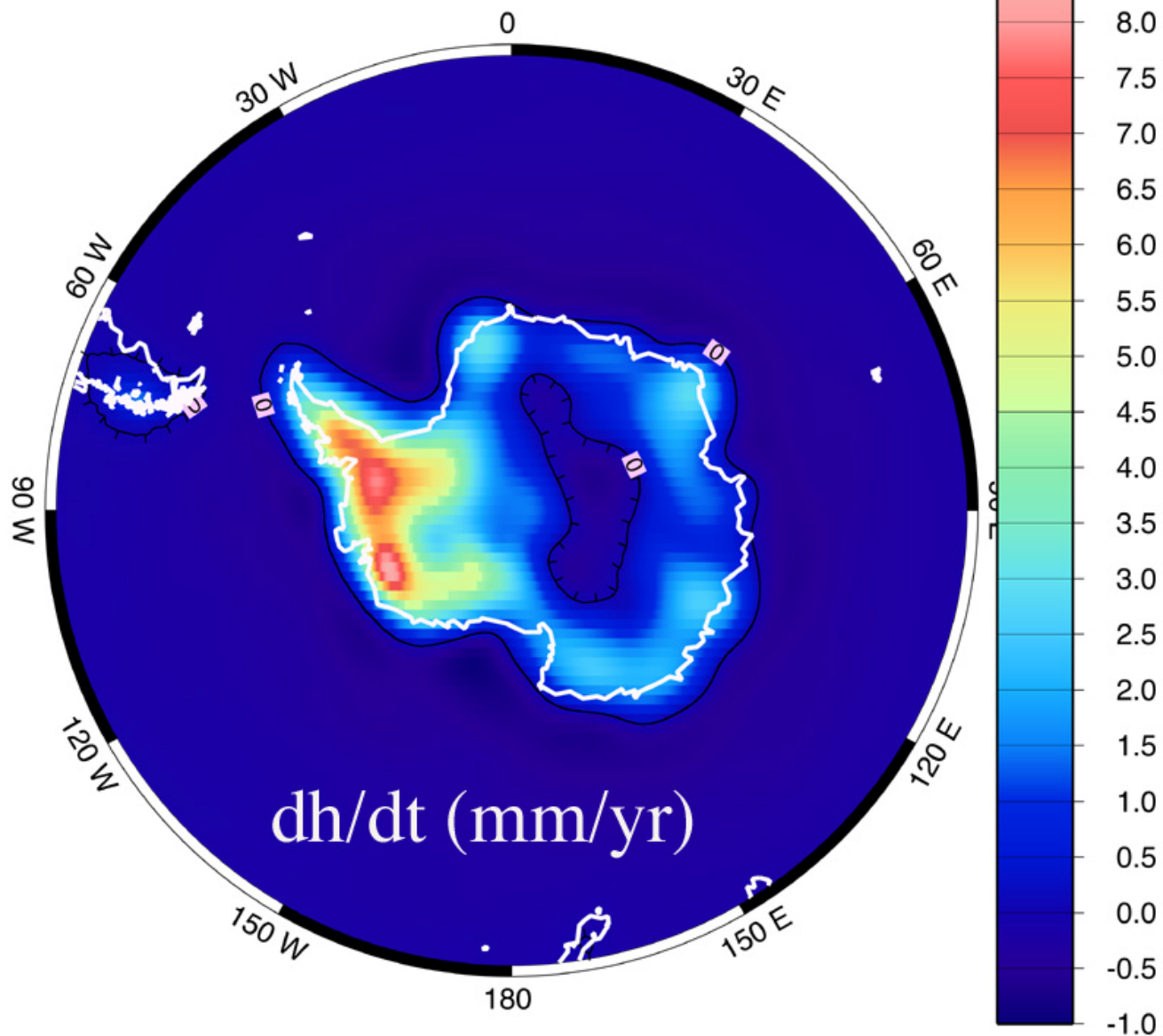
- Goal - evaluate ocean secular geoid signal as “noise” in the detection of Antarctic rebound/mass balance signal
- Problem - crustal monitoring stations are dominantly coastal

Geoid Rate change - mass imbalance 1990-2000



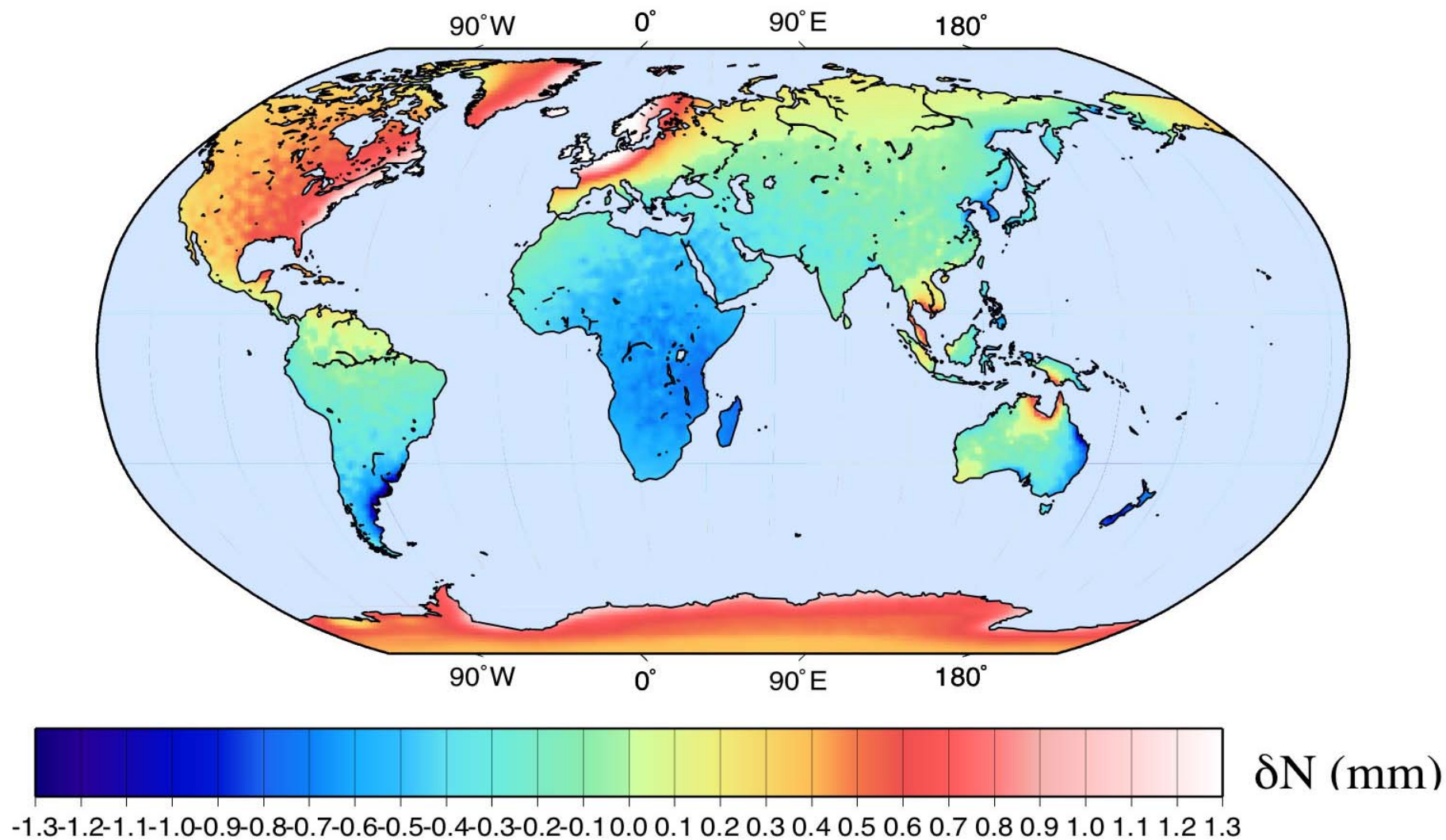
vertical uplift (mm/yr)

-- 1990-2000 mass loss + PGR



QuickTime™ and a
Video decompressor
are needed to see this picture.

02 Jan. 1992 geoid deviation from 20 yr ave. - degree 72 ECCO load



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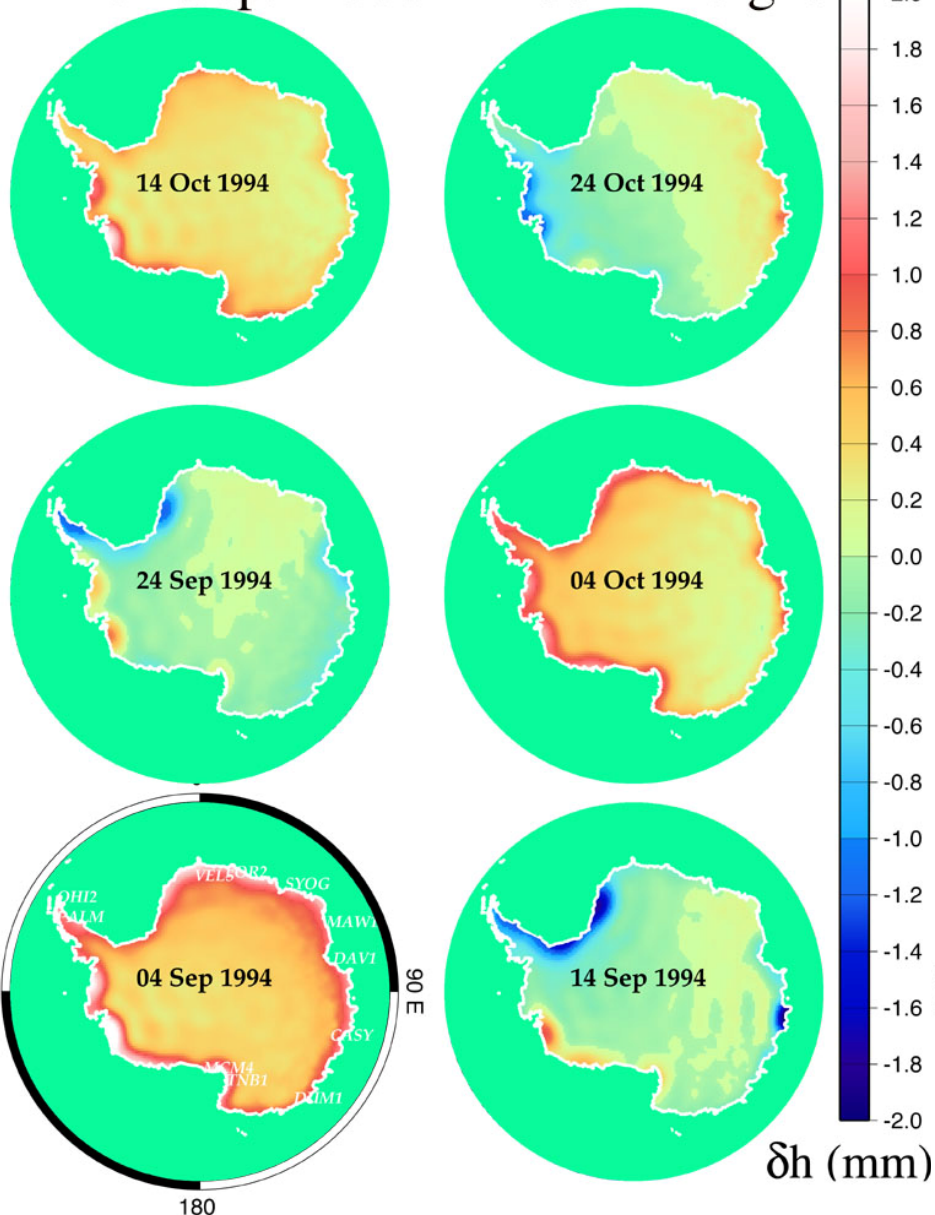
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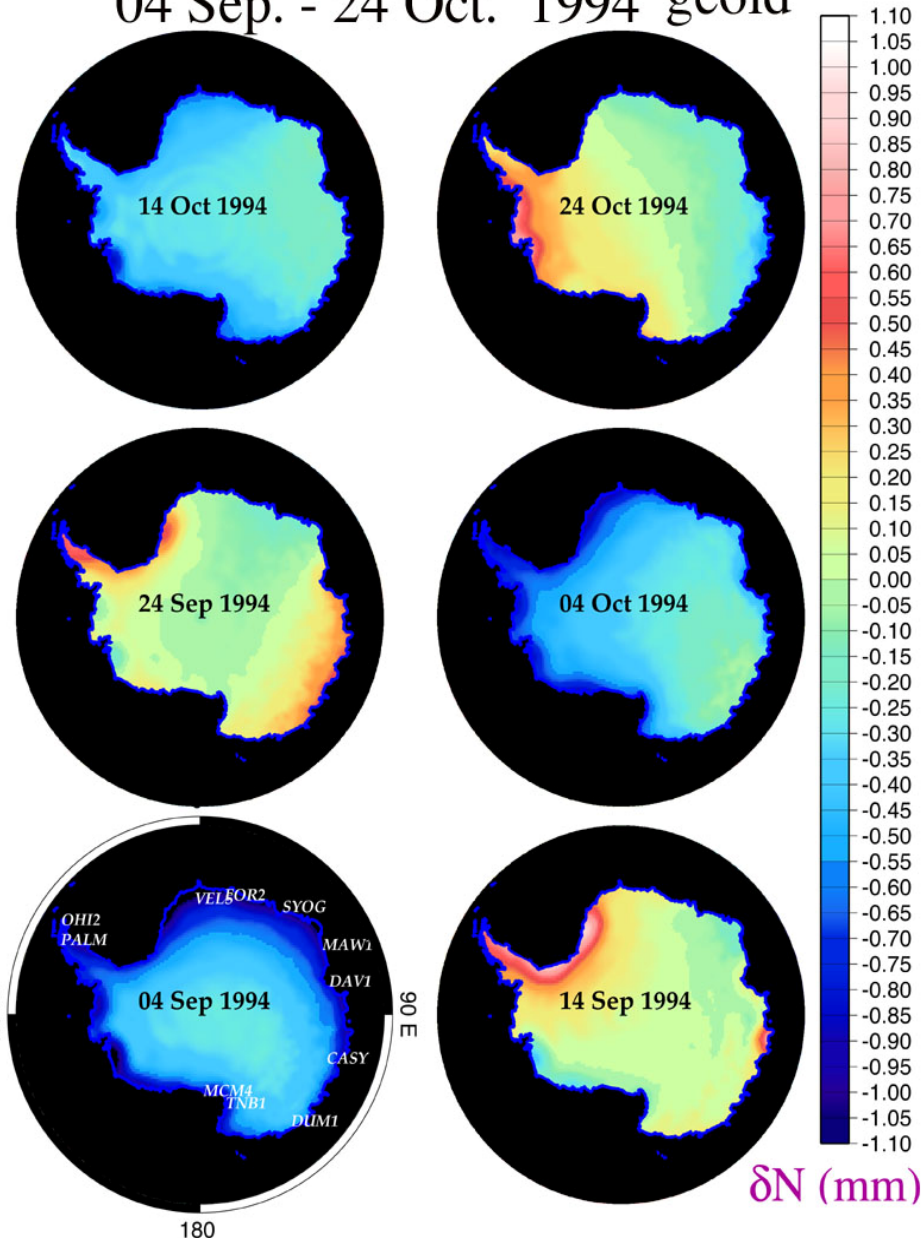
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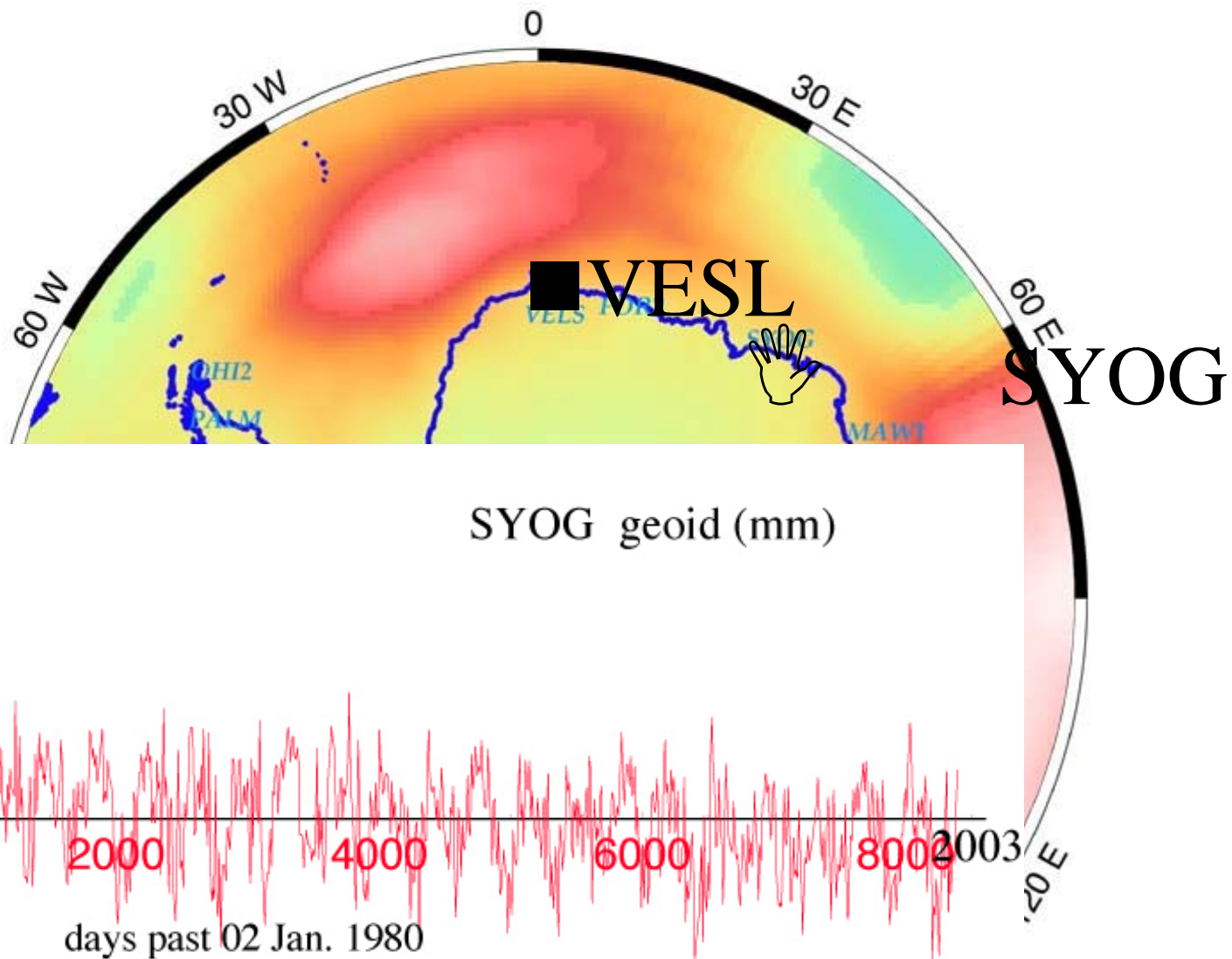
Austral spring

04 Sep. - Oct. 24 1994 height

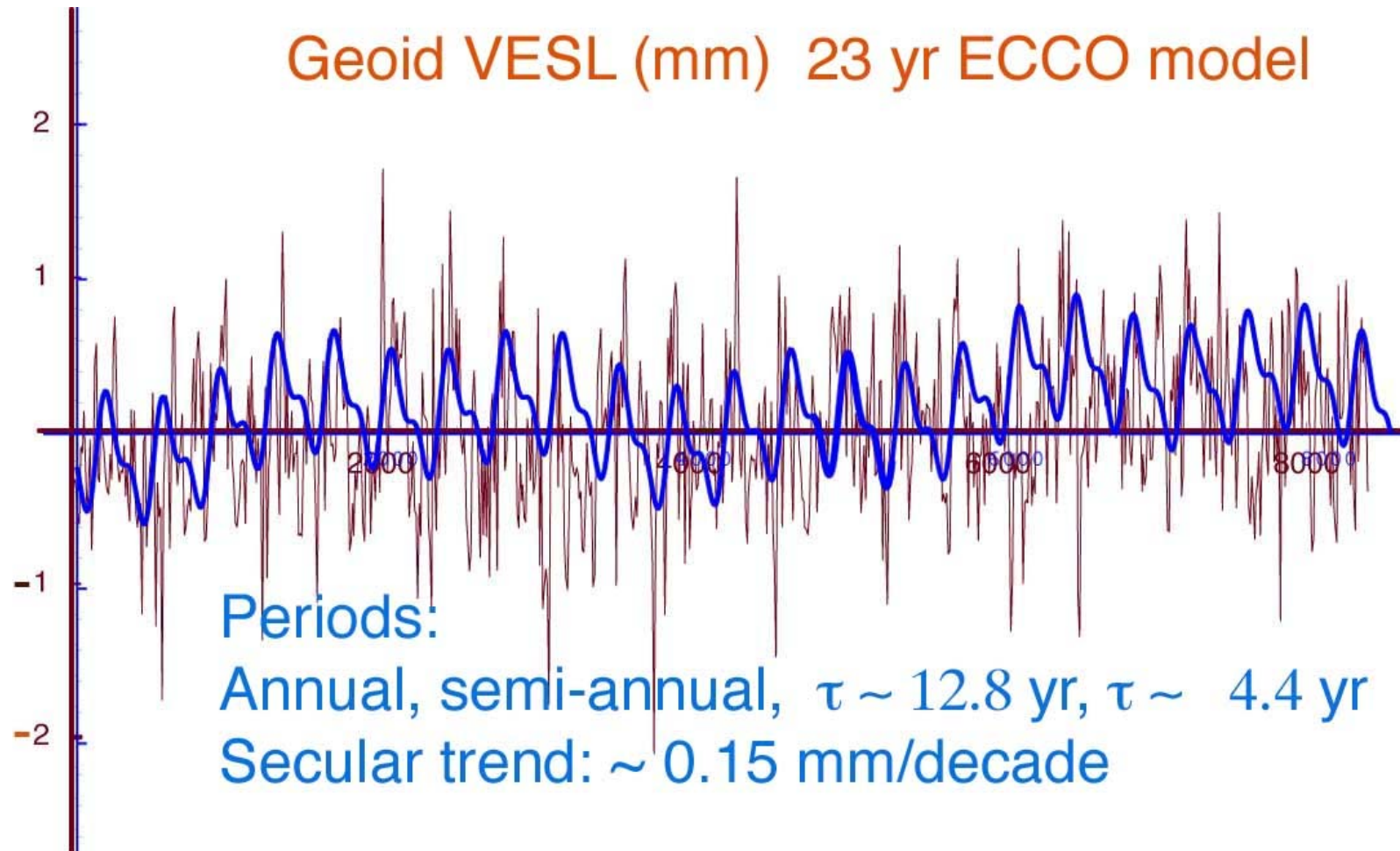


04 Sep. - 24 Oct. 1994 geoid





ECCO prediction at VESL

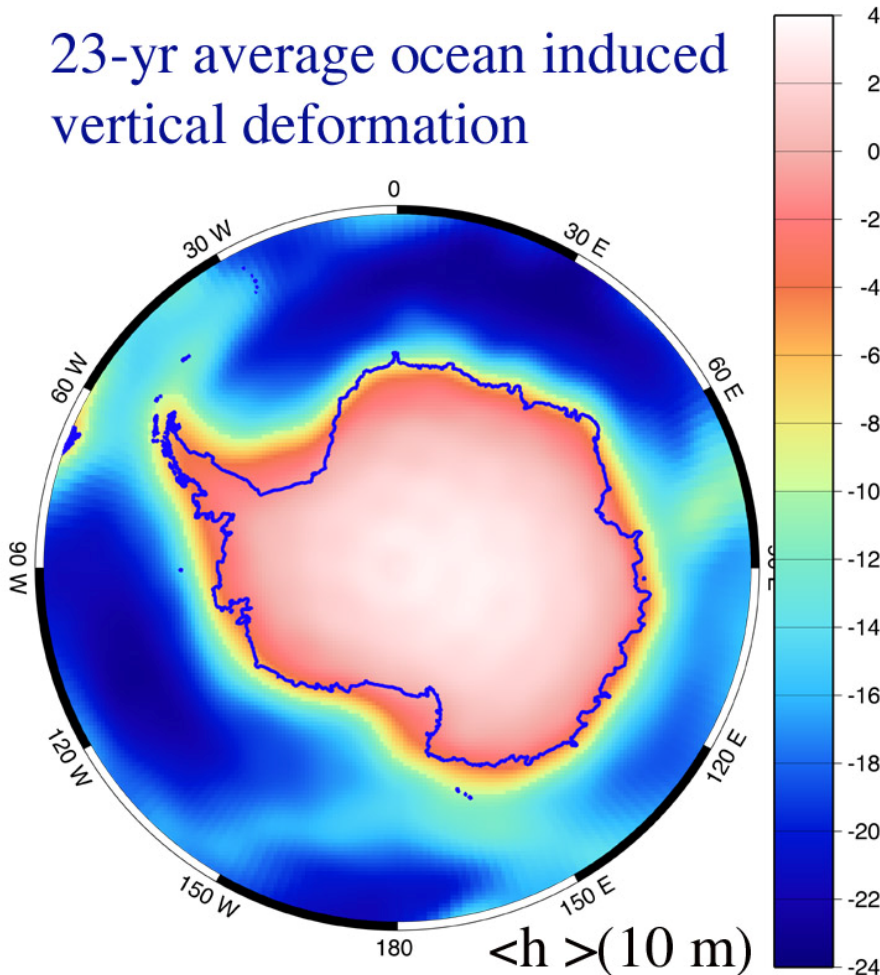


Conclusions

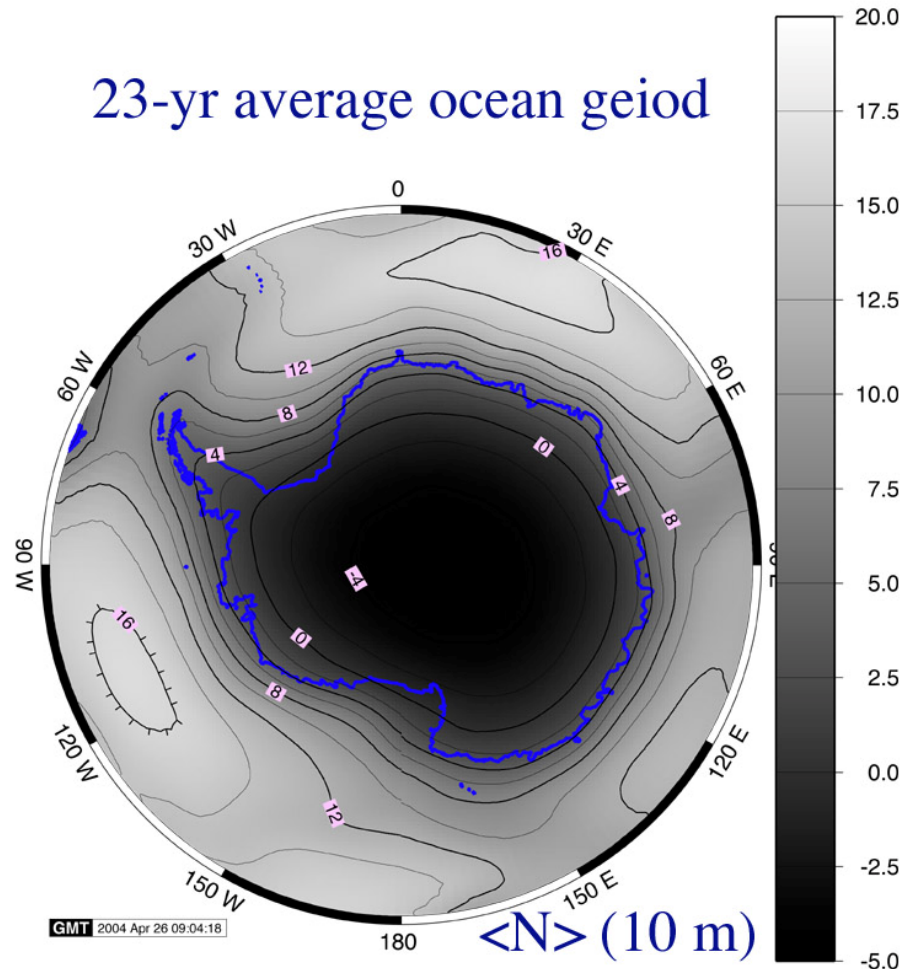
- Non-assimilated ECCO model allows examination of continental ACC geoid signature over land
- 23 yr. simulation indicates small 'secular' trends in geoid w.r.t. rebound & imbalance signatures
- Largest 5-year 'window' secular value is $\langle dN/dt \rangle \sim 0.06 - 0.08 \text{ mm/yr}$ (O'Higgins, Trinity Peninsula)
- Dronning Maud Land ice core record consistent with the dominant periods of the ECCO simulated ACC
- Short multiday - multiweek observations of rebound or mass balance **do need** ocean mass corrections (GOCE gravity, QC-GPS, GLAS)

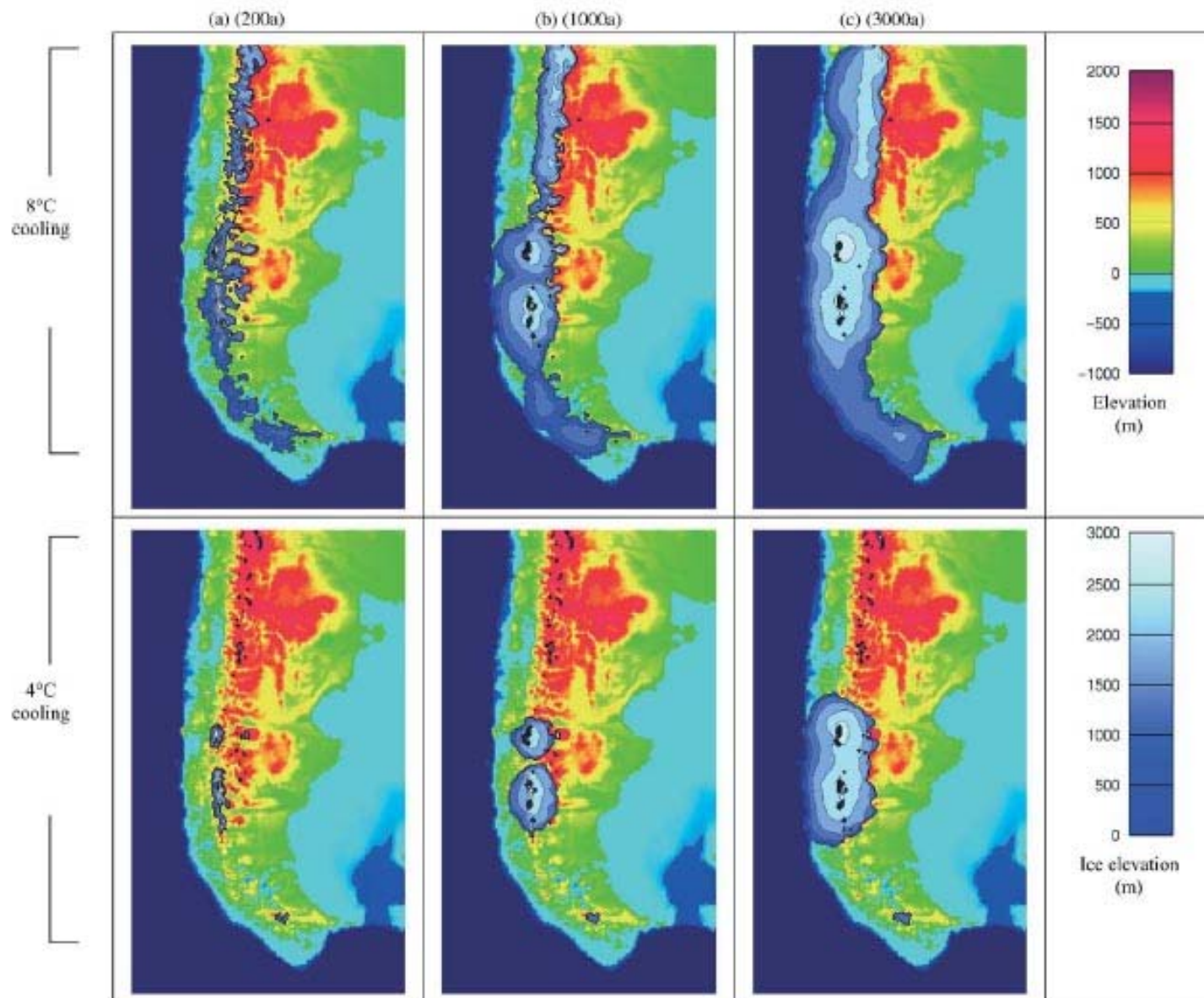
Geodetic fields induced by long-term background ocean mass

23-yr average ocean induced vertical deformation

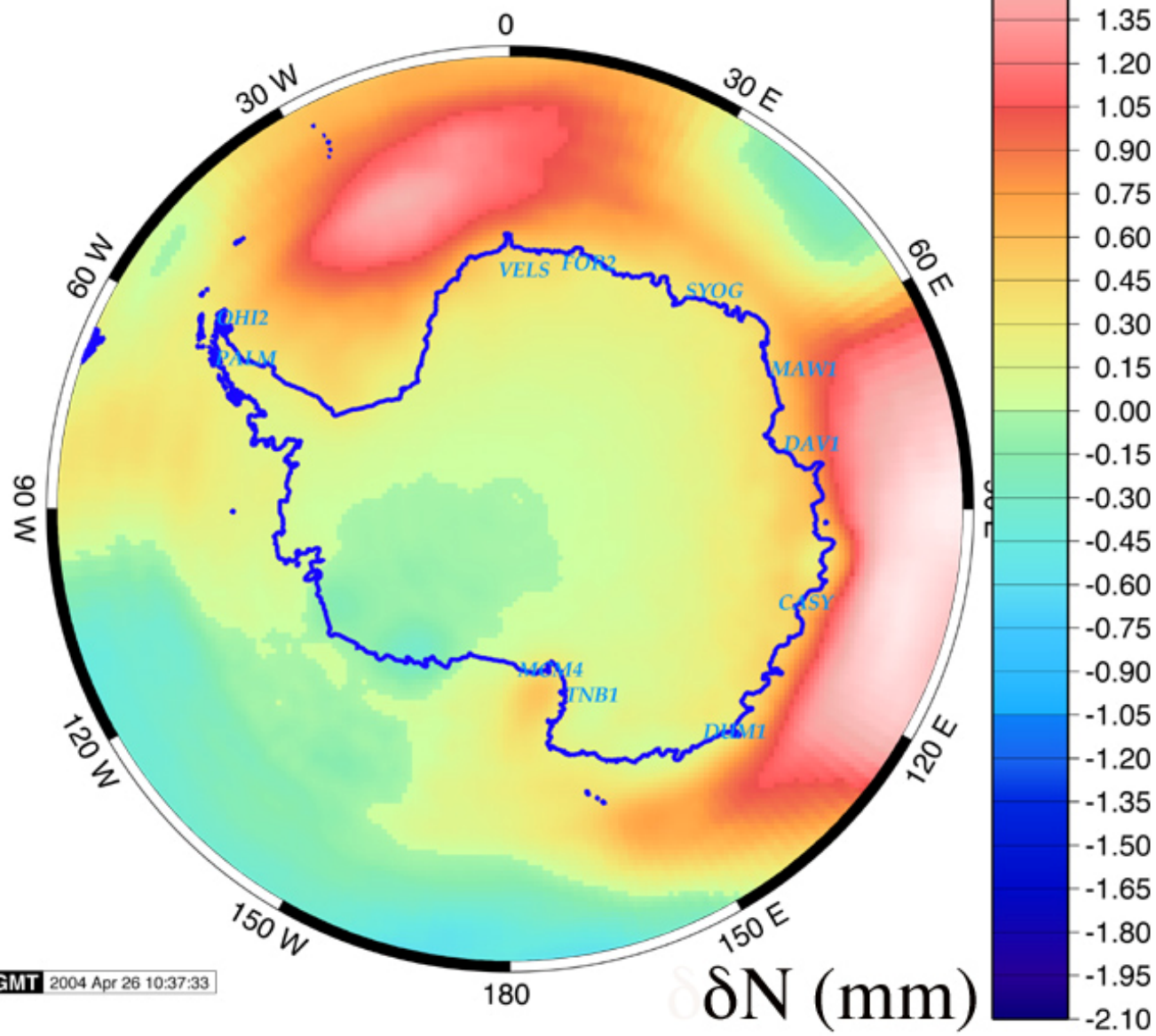


23-yr average ocean geoid



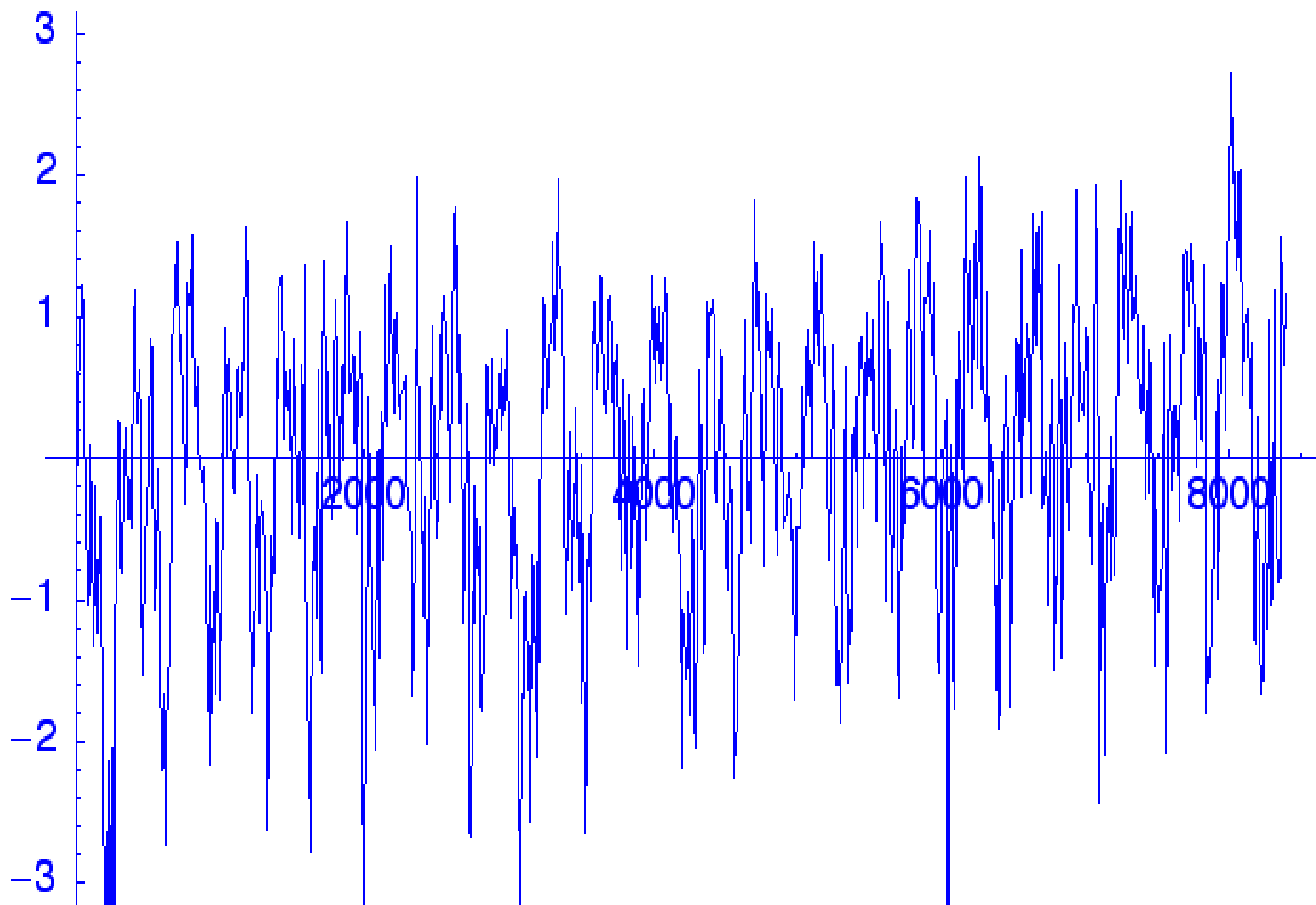


02 Jan. 94 geoid



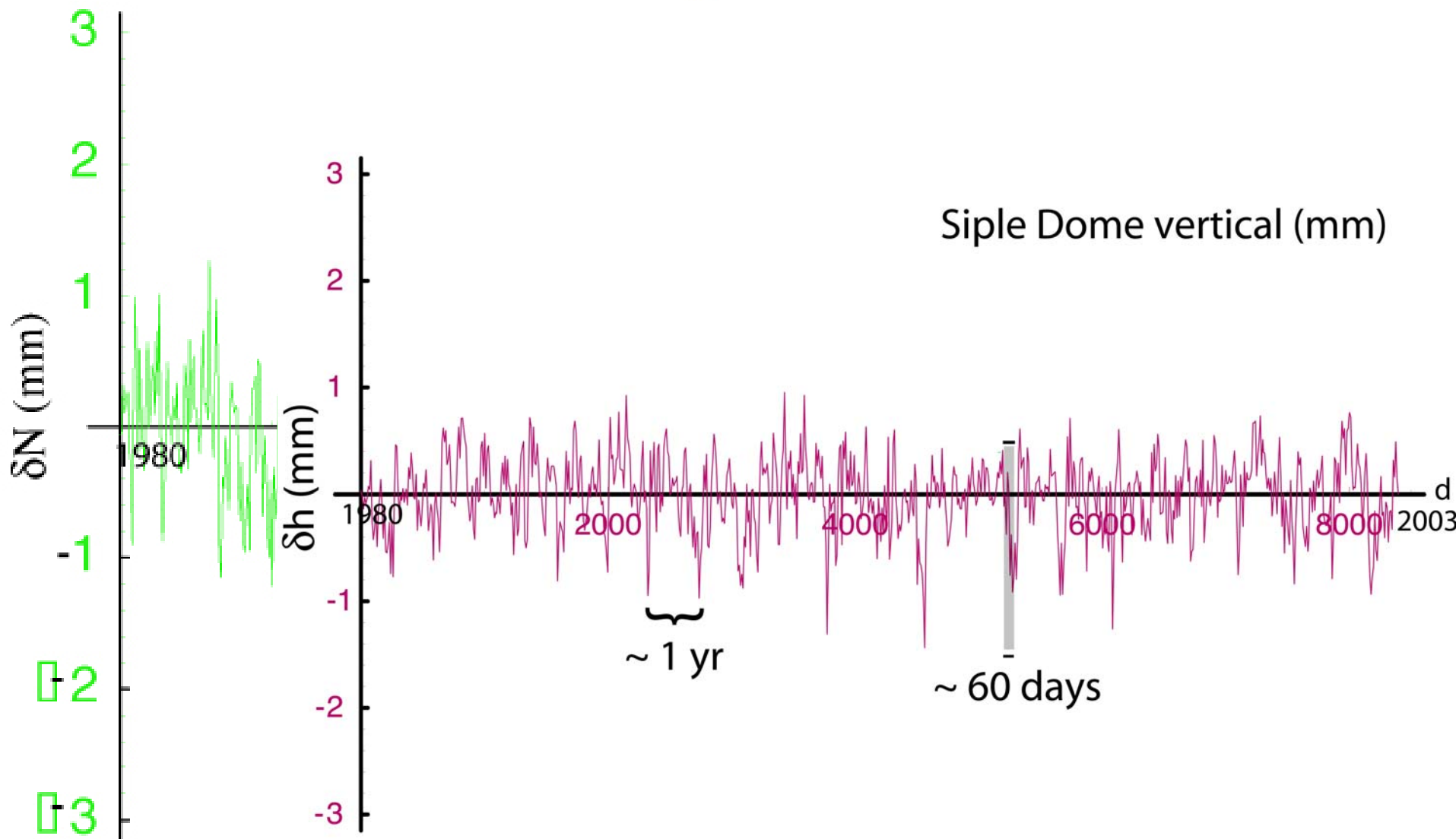
5/31/2005

KERG geoid



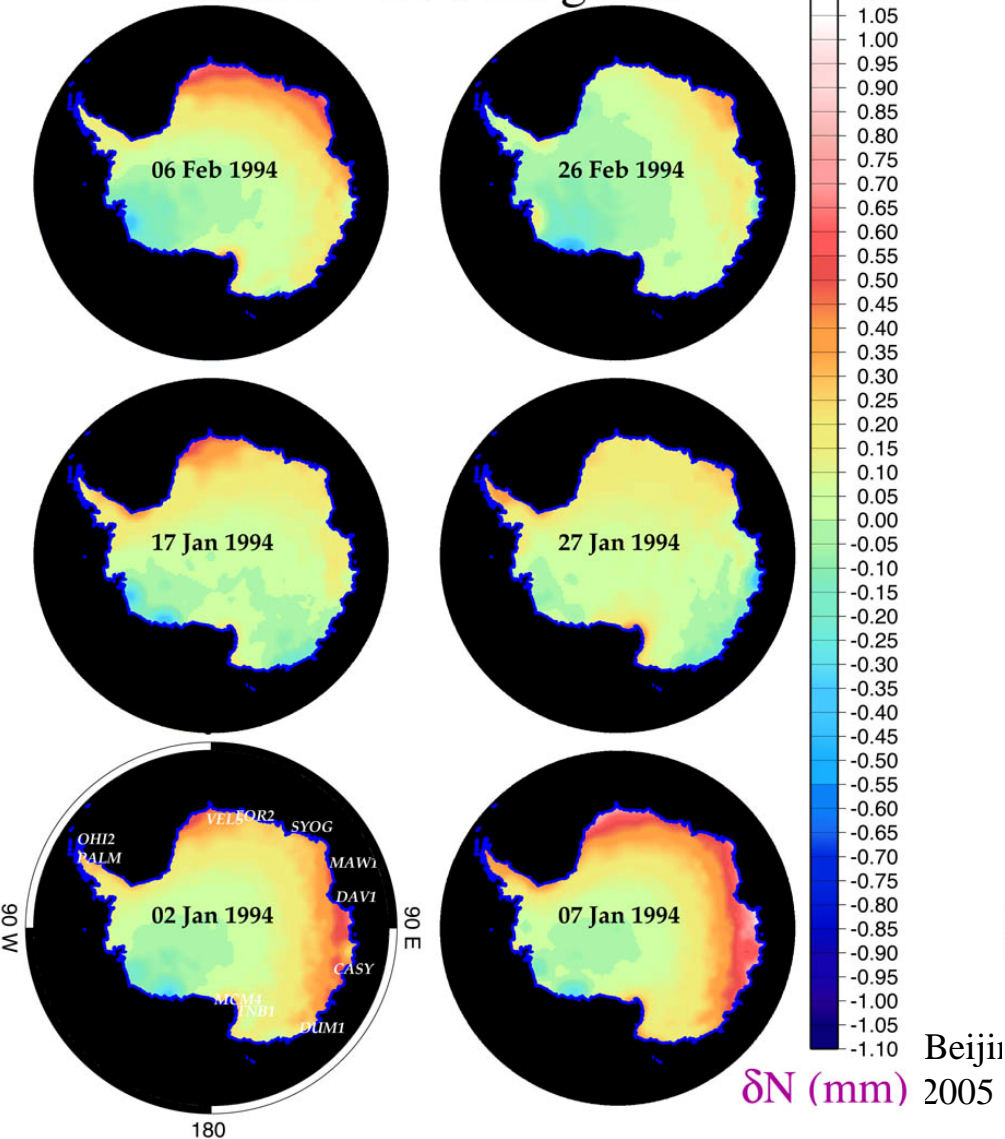
geoid at Siple Dome

OHIG geoid mm

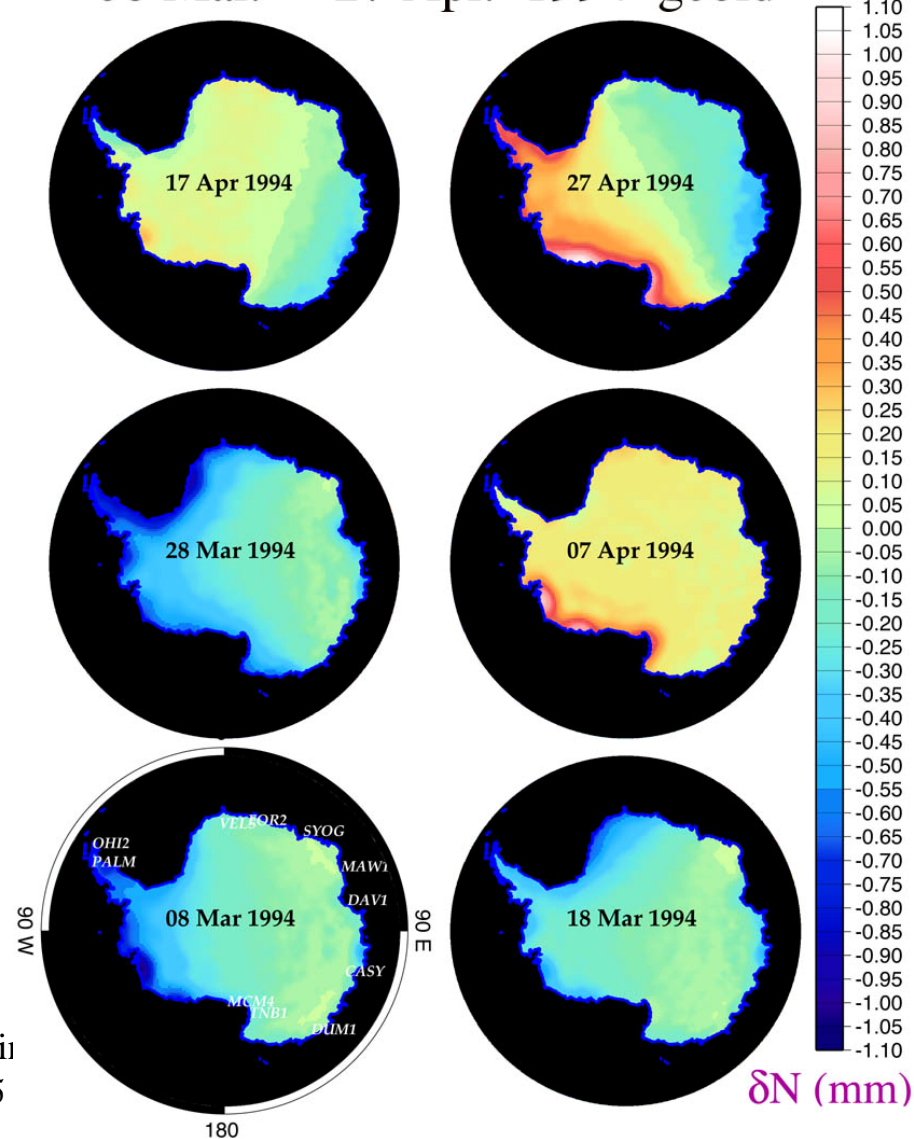


Fluctuating component for ECCO model

02 Jan. - 26 Feb. geoid

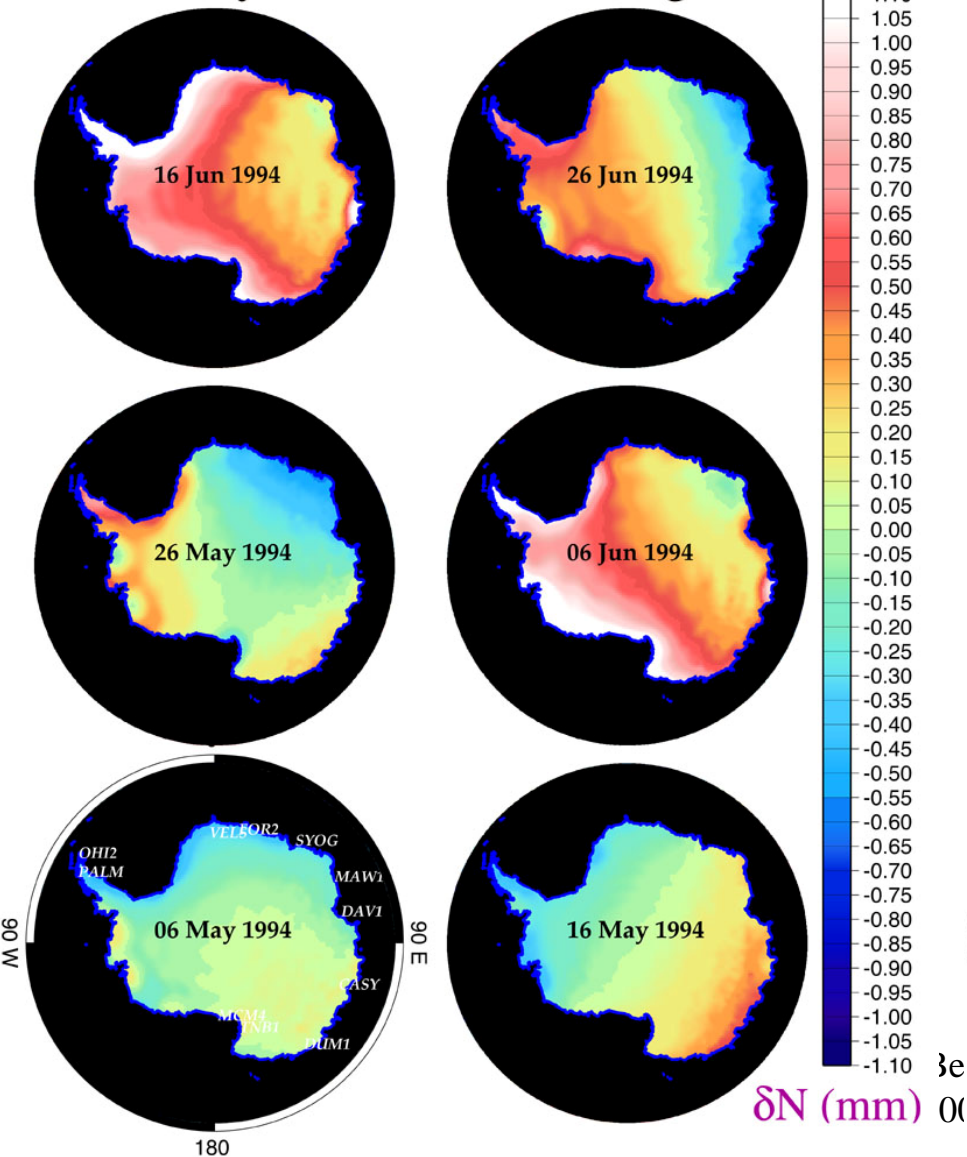


08 Mar. - 27 Apr. 1994 geoid

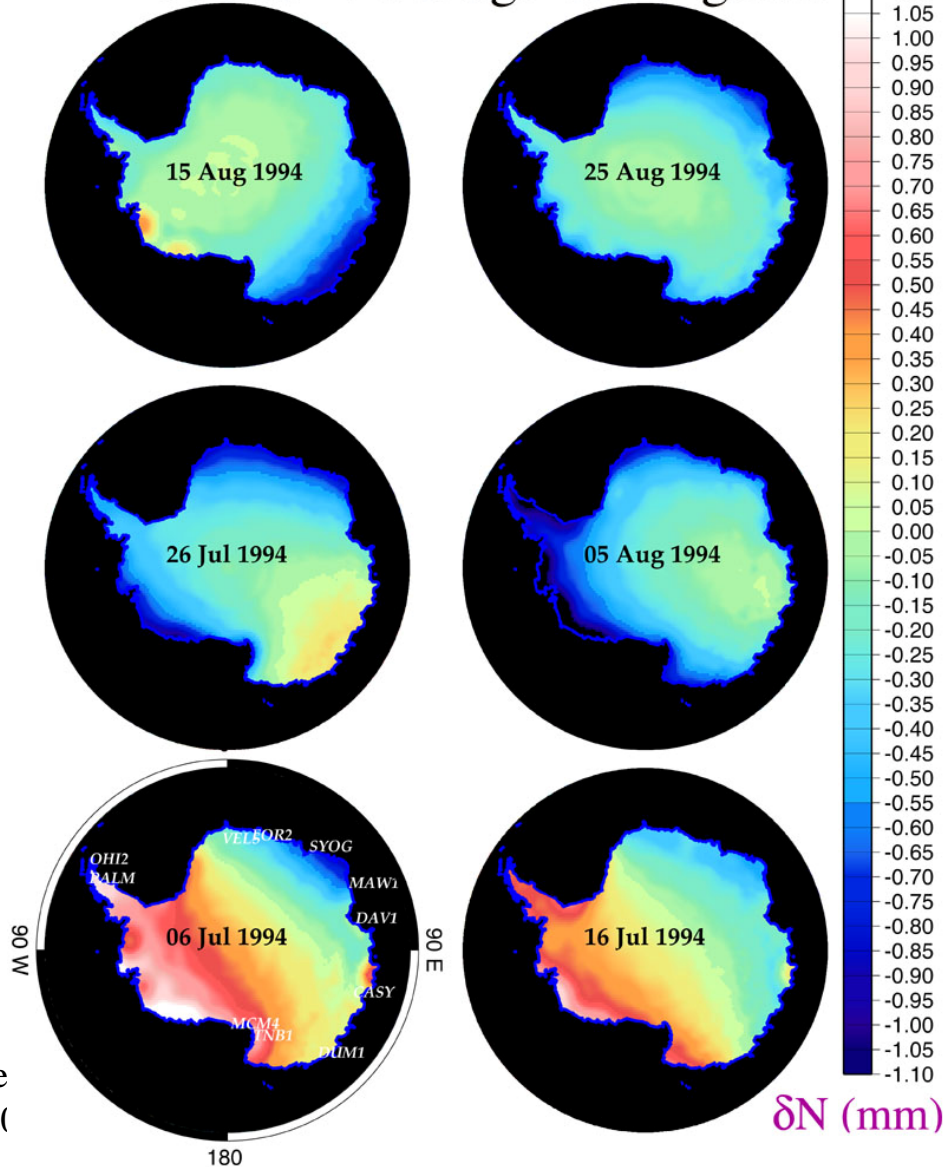


Antarctic Austral winter months

06 May - 26 Jun. 1994 geoid

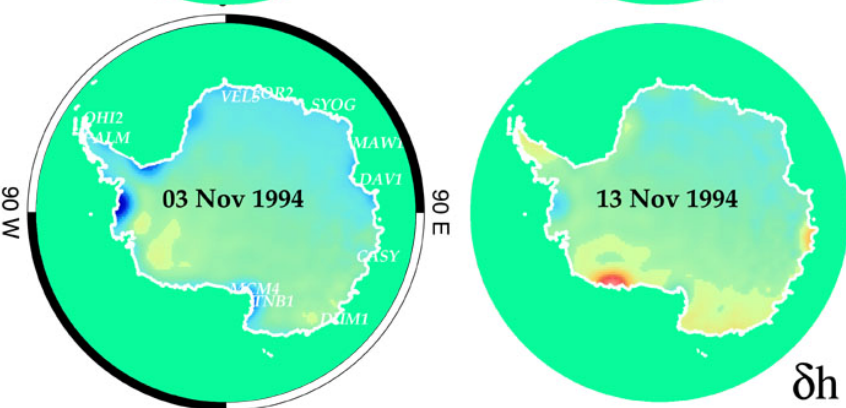
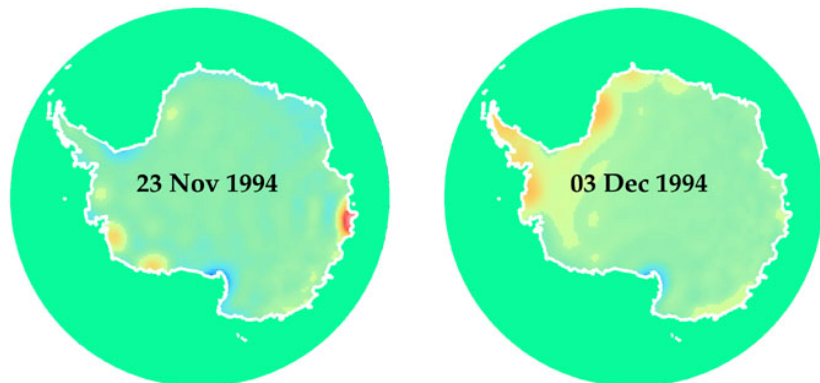
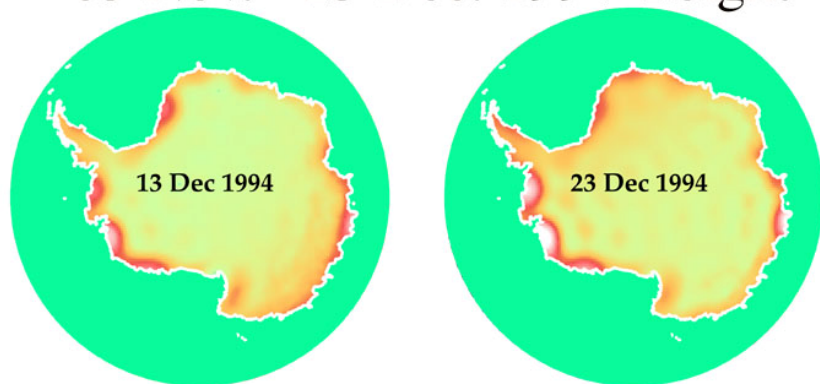


06 Jul. - 25 Aug. 1994 geoid



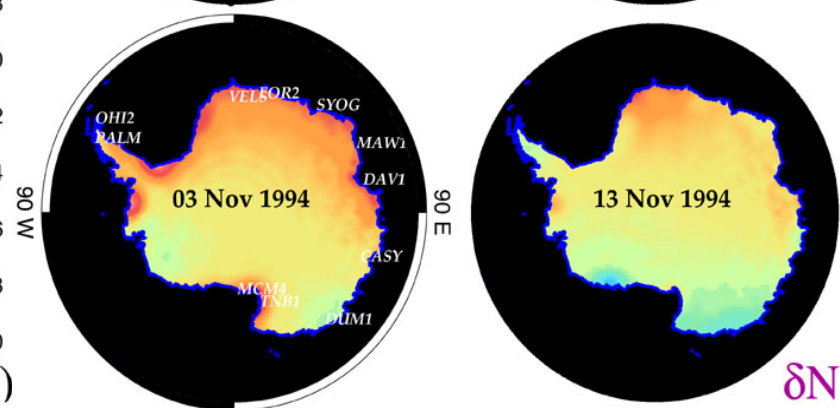
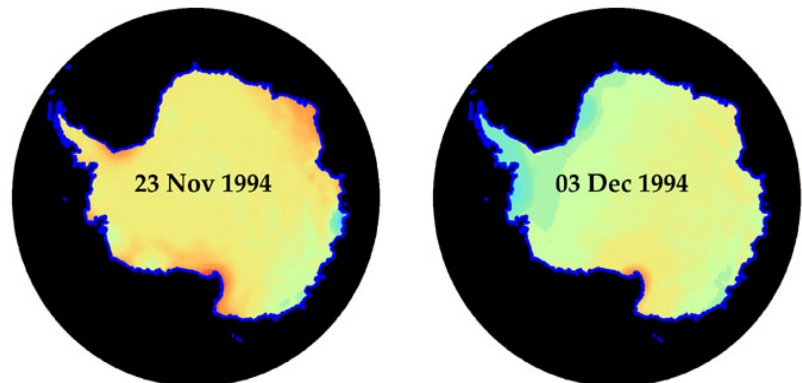
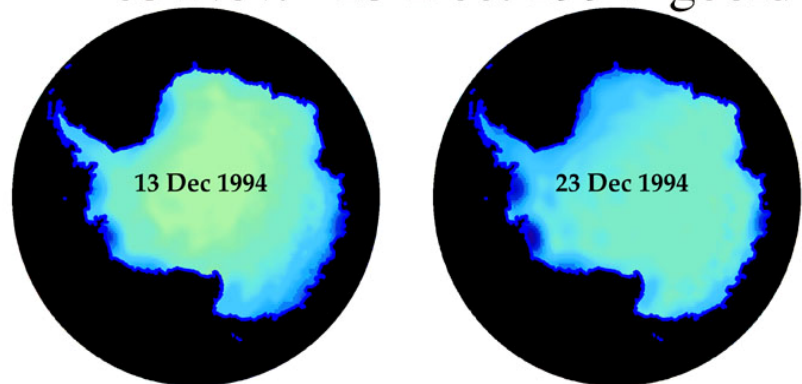
Austral summer

03 Nov. - 23 Dec. 1994 height



δh (mm)

03 Nov. - 23 Dec. 1994 geoid



δN (mm)

- Interdecadal or secular signals due to the Antarctic Circumpolar Current (ACC) ?
- Rebound geoid change detection ~ 0.25 mm/yr (**0.5mm/yr**)
- Rebound vertical rates $\sim 1 - 30$ mm/yr (**0.5 - 4 mm/yr**)
- Ice cores reveal two dominant periodicities: 12.8 & 4.4 yr. in ACC related precipitation in Dronning Maud Land



Ocean Mass Crustal Loading

- 23 year average from JPL/ECCO model run (1980 - 2003)
- fluctuations about mean every 10 d
- Truncation to degree/order = 72
- mass conservation and non-data assimilated (79.5N to 79.5 S)

